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Clinical outcomes for microvascular reconstruction in oral cancers: experience from a single surgical centre

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ABSTRACT

Introduction Reconstruction of a surgical defect is an important part of the management of oral cancers. Microvascular free flap construction provides better functional and cosmetic outcomes.

Methods Between 2014 and 2020, some 524 patients underwent microvascular reconstruction. Comorbidity variables were scored using the Charlson Comorbidity Index (CCI). Complications were recorded using Clavien–Dindo criteria.

Results Eighty-three (15.84%), 339 (64.69%) and 102 (19.47%) patients underwent free radial forearm flap, free anterolateral thigh flap and free fibula osteocutaneous flap (FFOCF), respectively. Clavien–Dindo complications of grade III and above were seen in 39 (7.44%) patients. Total flap loss was seen in 18 patients and of these, 16 were salvaged using alternative free flaps or pedicled flaps. On univariate analysis, overall and major complication rates were higher in FFOCF (p=0.171). Major complications significantly more common in patients with a CCI score >4 (p=0.001). Patients aged >65 years had higher rates of complications (p=0.03).

Conclusion Microvascular free tissue transfer is a reliable, safe and gold standard modality in surgical reconstruction and can be replicated in non-institutional settings.

KEYWORDS
Oral cancer – Microvascular free flap reconstruction – CCI

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Introduction

Cancer is one of the major causes of morbidity and mortality in every region of the world, irrespective of the level of economic development. Worldwide statistics indicate that there are 834,860 cases of head and neck cancer annually, resulting in approximately 431,131 deaths per year.[1] High incidence rates have been reported from developing countries including India, Pakistan, Bangladesh, Taiwan and Sri Lanka.[1,2]

Surgery is an important part of multimodal treatment for head and neck cancers. However, surgical resections for malignancies of the head and neck can be very challenging to reconstruct.[3] These defects are unique in demanding rehabilitation of form, function and aesthetic outcome following disfiguring surgical procedures. Pedicled flaps, principally the pectoralis major myocutaneous flap, have been used successfully since the 1960s to reconstruct head and neck defects.[3,4] Free tissue transfer for reconstructing such defects has been used only since the 1980s.[3] Having survived an era of doubt and scepticism, microvascular free flaps are now the gold standard in reconstruction.[3,5,6]

Advances in technique, better and refined instrumentation, accessible donor sites and better availability of training in this domain have helped reconstructive surgeons deliver far more predictable results in recent times. However, there remain challenges in constructing microvascular free flaps in a private setting in a developing country with limited resources and financial constraints.[7] In this retrospective study, we analyse and review the outcomes of microvascular free flap construction in patients with head and neck cancer for the period 2014–2020. The study was undertaken at our centre which is non-government-aided teaching institution.

Methods

This is a chart review of a prospectively maintained database of 524 patients at our centre who were treated between January 2014 and December 2020. Consecutive patients who underwent surgery for head and neck cancer requiring microvascular free flap reconstruction were included in this study. We included per primum

reconstruction as well as reconstruction for recurrent disease with prior surgery and/or radiation.

Relevant demographic, clinical, surgical, reconstruction and morbidity-related data were collected from a prospectively maintained database and from patients' medical records (Table 1). Comorbidity variables for all patients were stratified using Charlson Comorbidity Index (CCI)[8] for head and neck surgeries. All postoperative complications were recorded using Clavien–Dindo criteria.[9]

All cases included here were treated by a single head and neck surgery and plastic reconstructive team. The free flaps in our series were used to reconstruct various defects of anatomical sites in the oral cavity, namely buccal mucosa, maxilla, alveolus, tongue, palate and combined defects. Most were composite defects involving different types of tissues. The most commonly performed free flaps for reconstruction of defects at our centre were free anterolateral thigh flap (FALT), free fibula osteocutaneous flap (FFOCF) and free radial forearm flap (FRFAF). The types of surgical defects along with type of reconstruction are listed in Table 2.

Table 1 Demographic details

Variable	No. of cases (%)
Sex	
Male	444 (84.73)
Female	80 (15.26)
T stage	
T1/T2	50 (9.54)
T3/T4	474 (90.46)
N stage	
Node negative	150 (28.62)
Node positive	374 (71.37)
Clinical TNM stage	
I/II	22 (4.2)
III/IV	502 (95.8)
Charlson Comorbidity Index score	
<4	400 (76.33)
>4	124 (23.66)
Subsite	
Buccal mucosa	190 (36%)
Gingivobuccal sulcus	152 (29%)
Tongue	139 (27%)
Maxilla	26 (5%)
Lip	12 (2%)
Floor of mouth	5 (1%)
Treatment type	
Treatment naïve	469
Post NACT	34
Recurrent disease	11
Second primary	10

NACT = neoadjuvant chemotherapy

Free flaps were harvested at the time of the primary surgical procedure using a two-team approach. The vascularity of the flap pedicle was maintained until the time of flap transfer to the head and neck area. The majority of flaps were inset prior to microvascular anastomosis to prevent traction of the pedicle. The recipient vessel for anastomosis was identified and divided during neck dissection.

As per the institution's protocol, all patients undergoing major head and neck reconstruction were transported postoperatively, either intubated or tracheotomised (as necessary), to the surgical intensive care unit (ICU). Following extubation, patients were started on nasogastric tube feeds. Prophylactic injectable low-molecular-weight heparin to prevent thrombosis was used only in patients with cardiac issues or major osteocutaneous reconstructions. All patients received a once-daily dose of aspirin 75mg through the nasogastric tube for 7 days postoperatively. Flap monitoring was undertaken by nursing staff and residents, every 2 hours until the third postoperative day and thereafter every 6 hours until discharge. In the absence of any haemodynamic compromise, patients were moved from the ICU on the second postoperative day.

Prima facie, the flap and its progress were judged on its colour, temperature and the presence of brisk bright red bleeding on a needle-scratch. A postoperative management and care protocol was maintained in all patient charts. Changes in any of the above were reported immediately to the surgical team. If the changes were assessed to be a result of vascular compromise, the patient was shifted to the operating room for re-exploration.

Statistical analysis was done using SPSS version 20 (IBM Corp.).

Results

From January 2014 to December 2020, some 524 patients with oral squamous cell carcinoma underwent microvascular free flap reconstruction. The majority of the patients were male (n=444, 85%) with a median age

Table 2 Surgery details

Type	*N*	%
Wide excision	37	7
Composite resections (marginal+segmental)	365	70
Infrastructure maxillectomy/total maxillectomy	19	4
Major glossectomy (hemiglossectomy)	36	12
Major glossectomy+marginal/segmental mandibulectomy (NTG/TG)	67	7

of 48 years (range 17–85years) (Table 1). Most of the patients were treatment naïve (n=469, 89.5%), with the remainder having received some treatment prior to the current surgery (n=55, 11.5%). Neoadjuvant chemotherapy (NACT) was given to 34 patients; 11 patients presented with recurrent disease; and 10 patients had developed a second primary.

The subsite was broadly classified into buccal mucosa/gin/buccal sulcus (BM/GBS), tongue/floor of the mouth (TONGUE/FOM), maxilla and lip. BM/GBS cancers constituted most of the cases overall in in our study population. The particulars of the surgery undertaken and details of postoperative complications are given in Tables 2 and 3.

Mean operating room time was 6 hours for soft tissue reconstruction and 7.5 hours for bony reconstruction, measured from the time of induction until closure. Median length of hospital stay was 8 days (range 5–14 days), and was longer for osseous free flaps (10 days) than for non-osseous flaps (7 days).

Tracheostomy removal was done an average of 5–8 days postoperatively and the nasogastric tube was removed at 2 weeks in buccal mucosa defects and smaller tongue defects. In near-total or total glossectomies Nasogastric tube / Percutaneous endoscopic gastrotomy tube was kept for longer. The average hospital stay was approximately 8 days with an average ICU stay of 2 days.

Among the free flap reconstructions, 83 (15.84%), 339 (64.69%) and 102 (19.47%) patients underwent FRFAF, FALT and FFOCF reconstructions, respectively. Table 4 provides an insight into the details of postsurgical complication as per the Clavien–Dindo classification. Grade III and above complications were reported in 39 (7.44%) patients. Total flap loss was seen in 18 patients and of these 16 were salvaged using alternative free flaps or pedicled flaps. Donor site complications were recorded as seroma in two patients, bleeding in five and dehiscence in three patients.

Table 3 Complications

Variable	No. of procedures	No. of complications
Free flap type		
FRFAF	89	6
FALT	339	21
FFOCF	102	12
Complications:		
Major		
Total flap loss		18
Exploration under anaesthesia		11
Death		3
Prolonged ICU stay		7
Minor		
Partial flap loss/skin loss		12
Orocutaneous fistula		4
Dehiscence		3

FALT = free anterolateral thigh flap; FFOCF = free fibula osteocutaneous flap; FRFAF=free radial forearm flap; ICU = intensive care unit

Table 4 Clavien–Dindo classification for postsurgical complications

Category	No. of patients (%)
Grade IIIB	33 (6)
Grade IVA	3 (1)
Grade IVB	0 (0)
Grade V	3 (1)

On univariate analysis (Table 5), complications were seen to most affect patients reconstructed with FFOCF (p=0.171) although this was not significant. The same subset also showed higher rates of major complications. There was a definite trend in increased complication rates with higher CCI scores. Major complications were significantly more common in patients with a CCI score >4 (p=0.001). Patients >65 years of age showed a higher complication rate (p=0.03).

Discussion

Free tissue transfer employing microvascular anastomosis has been established as the gold standard in head and neck reconstruction.[3] Although many such reconstructions for head and neck defects have been published in literature, we aim to report our experience here.[3,4,6,10–14]

Microvascular free tissue transfer is an intricate surgical operation not only requiring adequate training and expertise, but also having a major bearing on operating room time dynamics.[4,11,12]

The procedure entails longer surgical time, and has a prolonged need for anaesthesia and resultant effects of the same on the body system. The metabolic, cardiorespiratory and haemodynamic overtones of prolonged anaesthesia affect the postoperative recovery window. The literature has abundant studies highlighting the association between increasing operative time and postoperative complications, including pulmonary embolism, surgical site infections and cardiac events.[15] In a large study, Kim *et al*[16] identified that the risk of complications increased with increased duration of anaesthesia, and that over 5 hours the mortality risks increased significantly. In our set-up, we work as exclusive ablative and reconstructive teams, thereby reducing surgery time, while maintaining a clear distinction in surgical duties between the teams and their members.

This series recorded patients over a wide age range (17 to 85, mean 48 years). No significant age-related predilection for complications was noted. Theoretically,

Table 5 Univariate analysis for factors affecting complication rate

Variable	All complications	*p* value	Major complications	*p* value
Age				
<65	50/474	0.127	22/474	0.02
>65	8/50		6/50	
T stage				
TI/T2	61	0.489	9	0.473
T3/T4	190	0.468	30	
Type of flap				
FFOCF	22/102	0.01	8/102	0.457
FALT	28/330		16/339	
FRFAF	8/83		4/89	
CCI score				
<4	35/401	0.005	10/401	0.001
≥4	23/121		18/121	

CCI = Charleson Comorbidity Index; FALT = free anterolateral thigh flap; FFOCF = free fibula osteocutaneous flap; FRFAF = free radial forearm flap

microvascular anastomosis might be considered difficult in the elderly, given the higher rates of vascular degenerative changes, namely intimal thickening due to atherosclerotic changes.[14] However, older candidates were observed to have encouraging outcomes despite age-associated comorbidities, as shown in our previous data set for that group.[17,18] This finding has support in the published literature.[12,19,20]

The CCI was used to stratify patients in the preoperative period. CCI scoring is a good predictor of postsurgical morbidity and mortality, as shown by a previous publication.[18] A higher CCI score was found to be associated with higher complication rates, and this trend was statistically significant >4 for major complication events. Clark *et al*[21] and Eskander *et al*[22] reported similar observations with increased comorbidities.

Clavien–Dindo classification is an objective scoring system for ratifying the degree of postoperative complications and adversities, which we use routinely in our audit.[9,23] In our series, the majority of patients presented with no complications that required additional care beyond expected routine. Events needing surgical interventions (grade III and above) occurred in 39 patients (7.44%). The majority of these were recorded in the early postoperative period (0–7 days; 36 patients) and the reminder in the late postoperative period. Mortality was recorded for three patients in our series during the early postoperative period (<7 days) owing to cardiac events in all cases. In their experience of 192 patients, McMahon *et al*[13] noted that one third reported with serious (grade III and above) complications, mainly wound-related and pulmonary. Classen and Ward,[6] Singh[24] and Haughey *et al*[25] reported total complication rates of 24.4%, 28% and 29%, respectively.

Large composite defects often demand complicated flap designs and insets, putting the flap at a higher risk of vascular compromise. In our series, complication rates were higher in free fibula flap reconstruction (12/102; 11.76%) compared with soft tissue reconstruction (27/422; 6.39%). McMahon *et al*[13] similarly noticed a higher percentage of losses and systemic complications associated with composite, osseous reconstructions.

Total flap loss is a distressing but infrequent complication of our series (18 patients; 3.43%). Such losses have been recorded only in the early postoperative period and require salvage flap reconstruction. Classen and Ward[6] reported a total flap loss incidence of 4.4% in their series. Salvage flaps were performed in 16 patients, and two patients with flap loss received no salvage reconstruction.

Copelli *et al*[26] and Okazaki *et al*[27] suggested in their analysis that the first choice for salvage of a failed free flap should always be a free flap, but in our experience, financial and monetary constraints have limited us from offering it in the salvage scenario.

Major complication rates (Clavien–Dindo grade III and above) in our series were approximately 7.44%. A great number were associated with the FFOCF. Although this needs further investigation, we believe the three-dimensional complex osteotomy and inset of this flap make it more prone to failure. Copelli *et al*[26] also reported that composite flaps were associated with more complications than soft tissue flaps.

An upward trend in complications was noted in patients with a CCI score >4; this was statistically significant for major complications, thus underlying the importance of comorbidities affecting flap success rates. Higher complication rates were observed in patients aged >65 years (12% compared with 4% in patients aged <65;

p=0.03), although this was not statistically significant. Ferrari *et al*[28] reported a success rate of 98.2% in 54/318 free flaps in patients over 75 years of age and 96.2% in 306/318 flaps performed in those under 75 years.

The surgical care of the patient in the mentioned setup is defined by a clear protocol for perioperative management. In a high-volume practice, in a developing nation, financial constraints necessitate frugal resource allocation. Hence, we do not routinely perform a colour Doppler or angiographic study of the donor site. In our practice, we rely on clinical identification of donor site vascularity and perforators on the operating table. In following this practice, we have seldom, if ever, had to change reconstructive strategy intraoperatively, again emphasising the point that these complex reconstructions are feasible outside institutional settings.

Our centre has been successful in maintaining good follow-up of all patients. Even in the recent COVID-19 pandemic, telephone and video consultations have helped maintain scrupulous follow-up.

The inherent issue with this paper is that this study is a retrospective evaluation at a single centre. A prospective multicentre design would offer deeper insight into most study variables with a close analysis of any minor interplay among them.

This study does not evaluate the quality of life of patients undergoing microvascular free tissue transfer. Quality of life is an arena of vast cognizance which should be investigated in future prospective models.

In a developing nation, the cost of surgery and hospitalisation is of relevance in the choice of reconstruction, because resource allocation for the various stages of a multidisciplinary treatment course is a tedious task. Singh *et al*, in their recent analysis, have also shown the increasing cost of surgery with advancing cancer stage due to the associated major reconstruction procedures.[29] Future studies must assess the cost/benefit ratio of performing free tissue transfer over other reconstructive techniques. Along similar lines, a risk/benefit analysis, comparing complication risk associated with free tissue transfer and benefit from such surgery, especially in an elderly frail comorbid population, is an avenue that requires attention.

Conclusion

Microvascular free tissue transfer requires a sophisticated level of skill and experience. Forming standard guideline-based protocols not only improves surgical results, but also improves aesthetic and morbidity-related outcomes. Microvascular free tissue transfer is a reliable safe and gold standard modality in reconstruction today, and can be replicated in non-institutional settings.

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